

11. Groundwater Quality

11.1 Introduction

This chapter describes the groundwater quality setting for the Extended, Secondary, and Primary study areas. Descriptions and maps of these three study areas are provided in Chapter 1 Introduction. Groundwater quality can be affected by both natural and human-caused activities. In natural systems, the quality of groundwater results from geochemical reactions between the water and rock as the water flows from areas of recharge. Typically, the longer that groundwater remains in contact with soluble materials, the greater the concentrations of dissolved materials in the water (in addition to the effects of temperature, pressure, and solubility). The quality of groundwater can also change as a result of the mixing of waters from different aquifers. Human-caused effects on groundwater quality can occur directly by the infiltration of compounds, or indirectly by alteration of flow or geochemical conditions. Groundwater chemistry may be influenced by irrigation water, wastewater from human activities, and by-products from industrial activities.

The regulatory setting for ground water resources is discussed briefly in this chapter, and is presented in greater detail in Chapter 4 Environmental Compliance and Permit Summary.

This chapter focuses primarily on the Primary Study Area. Potential impacts in the Secondary and Extended study areas were evaluated and discussed qualitatively. Potential local and regional impacts from constructing, operating, and maintaining the alternatives were described and compared to applicable significance thresholds. Mitigation measures are provided for identified significant or potentially significant impacts, where appropriate.

11.2 Environmental Setting/Affected Environment

11.2.1 Extended Study Area

11.2.1.1 Methodology

For the Extended Study Area, the existing groundwater quality conditions were evaluated using hydrologic regions as boundaries. There are 10 hydrologic regions in California; they consider varying climates, geography, and hydrology (See Figure 6-2 in Chapter 6 Surface Water Resources). These regions correspond to the state's major water drainage basins. Using the drainage basins as planning boundaries allows logical tracking of natural water runoff and accounting of surface and groundwater supplies. The CVP and SWP service areas of the Extended Study Area are located within nine of California's 10 hydrologic regions. San Luis Reservoir falls within the San Joaquin River hydrologic region.

North Coast Hydrologic Region

Overall, groundwater quality in the North Coast Hydrologic Region is very good. Groundwater quality problems in this region include contamination from seawater intrusion and nitrates in shallow coastal groundwater aquifers; high total dissolved solids (TDS) and alkalinity in groundwater associated with the lake sediments of the Modoc Plateau basins; and iron, boron, and manganese in the inland groundwater basins of Mendocino and Sonoma counties. Septic tank failures in western Sonoma County, at Monte Rio

and Camp Meeker, and along the Trinity River downstream of Lewiston Dam, are a concern because of potential impacts to groundwater wells and recreational water quality (DWR, 2005).

From 1994 through 2000, samples were taken from 584 public supply wells in 32 of the 63 basins and subbasins in this region. Of these wells, 95 percent met the state primary MCLs for drinking water, and the remaining five percent of wells sampled exceeded one or more MCL (DWR, 2003).

San Francisco Bay Hydrologic Region

Groundwater quality throughout much of the San Francisco Bay Hydrologic Region is of good quality and suitable for most urban and agricultural uses with only local impairments, such as leaking underground storage tanks. Primary constituents of concern are high TDS, nitrate, boron, and organic compounds. The areas of high TDS (and chloride) concentrations are typically found in the region's groundwater basins that are situated close to the San Francisco Bay, such as the northern Santa Clara, southern Sonoma, Petaluma, and Napa valleys. Elevated levels of nitrate have been detected in a large percentage of private wells tested within the Coyote Subbasin and Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin (in the Central Coast Hydrologic Region,) located to the south of the Santa Clara Valley (SCVWD, 2001). The shallow aquifer zone within the Petaluma Valley also shows persistent nitrate contamination. Groundwater with high TDS, iron, and boron levels were present in the Calistoga area of Napa Valley, and elevated boron levels in other parts of Napa Valley make the water unfit for agricultural uses. Releases of fuel hydrocarbons from leaking underground storage tanks and spills/leaks of organic solvents at industrial sites have caused minor to significant groundwater impacts in many basins throughout the region. Methyl tertiary-butyl ether (MTBE) and chlorinated solvent releases to soil and groundwater continue to be problems (DWR, 2003).

From 1994 through 2000, samples were taken from 485 public supply water wells in 18 of the 33 basins and subbasins in this region. Analyzed samples indicate that 410 wells, or 85 percent, met the state primary MCLs for drinking water standards, and 75 wells, or 15 percent, have constituents that exceed one or more MCL (DWR, 2003).

Central Coast Hydrologic Region

Much of the groundwater in the Central Coast Hydrologic Region is impaired due to high mineralization. It is characterized by calcium sulfate to calcium sodium bicarbonate sulfate water types resulting from marine sedimentary rock in the watersheds. Water character is determined from chemical analyses by the dominant positively charged cation (e.g., sodium, calcium, or magnesium) with the dominantly negatively charged anion (e.g., chloride, sulfate, or bicarbonate). Where dominant cations and anions are not present there may be a combination of several compositions. Water quality problems most frequently encountered in the Central Coastal Basin pertain to excessive salinity or hardness of local ground waters. In some of the coastal groundwater basins, groundwater is pumped at a higher rate than the underground supply is replenished, such that seawater has pushed into some coastal freshwater aquifers and is degrading groundwater quality. Aquifers intruded by seawater are typically characterized by sodium chloride to calcium chloride, and have chloride concentrations greater than 500 mg/L. Groundwater basins that are affected by salinity include the Hollister area, the Carrizo Plain, the Santa Maria and Cuyama valleys, San Antonio Creek Valley, portions of the Santa Ynez Valley, and the Goleta and Santa Barbara areas. In several areas, groundwater exceeds the MCL for nitrate.

In the southern portion of Santa Clara County, elevated concentrations of nitrate and perchlorate have been detected. In late 2002, perchlorate emerged as a significant groundwater contaminant in the southern

end of Santa Clara County. The known extent of this groundwater chemical plume extends 10 miles, and more than 800 water supply wells have been affected (DWR, 2005).

From 1994 through 2000, samples were taken from 711 public supply water wells in 38 of the 60 basins and subbasins in this region. Analyzed samples indicate that 587 wells, or 83 percent, met the state primary MCLs for drinking water, and 124 wells, or 17 percent, have constituents that exceed one or more MCL (DWR, 2003).

South Coast Hydrologic Region

The South Coast Hydrologic Region is divided into three subregions: Los Angeles, Santa Ana and San Diego. Groundwater in basins of the Los Angeles subregion is mainly calcium sulfate and calcium bicarbonate in character. Nitrate content is elevated in some parts of the subregion. Volatile organic compounds (VOCs) have created groundwater impairments in some of the industrialized portions of the region. The San Gabriel Valley and San Fernando Valley groundwater basins both have multiple sites of contamination from VOCs. The main constituents in the contamination plumes are trichloroethylene (TCE) and tetrachloroethylene (PCE). Some of the locations have been declared federal Superfund sites. Contamination plumes containing high concentrations of TCE and PCE also occur in the Bunker Hill Subbasin of the Upper Santa Ana Valley Groundwater Basin. Some of these plumes are also designated as Superfund sites. Perchlorate is emerging as an important contaminant in several areas in this region.

Groundwater in basins of the Santa Ana subregion is primarily calcium and sodium bicarbonate in character. Local impairments from excess nitrate or VOCs have been recognized. Groundwater and surface water in the Chino Subbasin of the Santa Ana River Valley Groundwater Basin have elevated nitrate concentrations, partly derived from a large dairy industry in that area. In Orange County, water from the Santa Ana River provides a large part of the groundwater replenishment. The primary groundwater character in the San Diego subregion includes a combination of calcium and/or sodium cation, and bicarbonate and/or sulfate anions. Localized groundwater quality impairments by nitrate, sulfate, and TDS are found in this subregion. Camp Pendleton Marine Base, in the northwestern part of this subregion, is on the USEPA National Priorities List for soil and groundwater contamination by many constituents.

From 1994 through 2000, samples were taken from 2,342 public supply water wells in 47 of the 73 basins and subbasins in this region. Analyzed samples indicate that 1,360 wells, or 58 percent, met the state primary MCLs for drinking water, and 982 wells, or 42 percent, have constituents that exceed one or more MCL (DWR, 2003).

Sacramento River Hydrologic Region

Overall, groundwater quality in the Sacramento River Hydrologic Region is good, although there are local groundwater quality impairments. Natural water quality impairments occur at the northern end of the Sacramento Valley in the Redding subbasin, and along the margins of the valley and around the Sutter Buttes, where Cretaceous age marine sedimentary rocks containing brackish to saline water are near the surface. Groundwater near the Sutter Buttes is impaired because of local volcanic geology, and hydrogen sulfide is a problem in wells in the geothermal areas in the western part of the region. Human-induced impairments are usually associated with individual septic system development in shallow unconfined portions of aquifers, or in fractured hard rock areas where insufficient soil depths are available to properly leach effluent before it reaches the local groundwater supply. Some groundwater sources in this region do not meet State secondary MCLs for iron and manganese, and heavy metals from historical burn dumps

also contaminate groundwater locally. In the Sierra foothills there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Perchlorate, previously used as an oxidizer or booster for solid rocket fuel and now a human health concern in domestic water, has contaminated wells in Rancho Cordova, near Sacramento (DWR, 2005).

In the mountainous portions of this region, groundwater is of fairly good quality, but it may be contaminated by naturally occurring radon, uranium, or sulfide mineral deposits containing heavy metals. In particular, radon contamination is associated with granite, such as the granite batholith of the Sierra Nevada. Some groundwater sources do not meet State secondary MCLs for iron and magnesium. Also, because of the lack of community wastewater systems, individual septic tanks are prevalent for rural residential development in this region. The failure of septic tank systems can create sewage flows that have the potential to adversely affect nearby wells and groundwater quality.

From 1994 through 2000, samples were taken from 1,356 public supply water wells in 51 of the 88 basins and subbasins in the Sacramento River HR. Samples analyzed indicate that 1,282 wells, or 95 percent, met the state primary MCLs for drinking water, and 74 wells, or five percent, have constituents that exceed one or more MCL (DWR, 2003).

San Joaquin River Hydrologic Region

Groundwater quality throughout the San Joaquin River Hydrologic Region is adequate for most urban and agricultural uses. However, there are approximately 1,000 square miles overlying groundwater along the western edge of the valley floor that are contaminated with high salinity from naturally occurring marine sediments of the Coast Range. The salinity of groundwater in the region can increase as a result of agricultural practices in which the evapotranspiration of crops and wetlands leaves behind the majority of salts contained in the imported water (either imported surface water or groundwater). In addition, high water-table conditions underlying marginal lands along the west side of the San Joaquin River region contribute to subsurface drainage problems. To maintain a salt balance in the root zone, much of this salt is leached into the groundwater.

Nitrates that are generated from the disposal of human and animal wastes, or from the inefficient application of fertilizer and irrigation water, have contaminated 200 square miles of groundwater in the region, and threaten some domestic water supplies. Pesticides have contaminated 500 square miles of groundwater basins, primarily in agricultural areas on the east side of the San Joaquin Valley, where soil permeability is higher and the depth to groundwater is shallower. The entire Central Valley has approximately 500,000 single-family residential septic systems, each with leach fields that discharge to the groundwater. The most notable agricultural contaminant detected in groundwater samples from this region is dibromochloropropane (DBCP), which is a banned nematode pesticide that has been found mostly along the SR 99 corridor. There are also approximately 200 square miles of groundwater basins that are contaminated by naturally occurring selenium (DWR, 2005).

In the mountainous portions of this region, groundwater is of good quality, but it may be contaminated by naturally occurring radon, uranium, or sulfide mineral deposits containing heavy metals. In particular, radon contamination is associated with granite, such as the granite batholith of the Sierra Nevada. Some groundwater sources do not meet State secondary standards for both iron and magnesium. Also, because of the lack of community wastewater systems, individual septic tanks are prevalent for rural residential development in this region and have the potential to adversely affect nearby wells and groundwater quality.

From 1994 through 2000, samples were taken from 689 public supply water wells in 10 of the 11 basins and subbasins in this region. Samples analyzed indicate that 523 wells, or 76 percent, met the state primary MCLs for drinking water, and 166 wells, or 24 percent, have constituents that exceed one or more MCL (DWR, 2003).

Tulare Lake Hydrologic Region

Groundwater quality in the Tulare Lake Hydrologic Region is suitable for most beneficial uses; however, there are several areas with impairments to groundwater. On the region's west side, salinity, sulfate, boron, chloride, and selenium limit the uses of groundwater. Salinity is the primary water quality factor affecting use of groundwater for irrigation and native habitat. Where groundwater quality is marginal to unusable for agriculture, farmers use good quality surface water to irrigate crops or blend higher quality surface water with poor quality groundwater to create a larger supply. The inefficiency of some crop irrigation systems can increase percolation of irrigation water into the shallow unconfined aquifers, causing drainage problems and degrading groundwater quality. This marginal to poor quality groundwater has mounded up to reach crop root zones in that area and is threatens the viability of agriculture there.

Agricultural runoff and drainage are also the main sources of nitrate, pesticides, and selenium that endanger groundwater and surface water beneficial uses. The basin also has a relatively large concentration of dairies that contribute microbes, salinity, and nutrients to both surface water and groundwater.

Nitrate has contaminated more than 400 square miles of groundwater in the Tulare Lake Basin. In addition, oilfield waste has affected water quality. There are more than 800 oilfield waste dischargers, of which 250 are regulated pursuant to waste discharge requirements (CVRWQCB, 2002).

Naturally occurring arsenic, as well as pesticides and industrial chemicals, have contaminated some groundwater supplies that are used for domestic water in the region. With newer federal and State drinking water rules being implemented over the past few years, numerous community domestic water well sources are noncompliant and have had to implement treatment methods or plans to reduce arsenic levels in drinking water. The contamination of almost 50 wells in Fresno/Clovis area due to high levels of DBCP and/or TCE, and other organic compounds resulted in the installation of activated charcoal filtration systems to remove these contaminants from the well water.

For many years, portions of the Tulare Lake region have experienced significant drainage problems, exacerbated by the fact that it is a basin with no significant water outflow to remove salts. The poorly drained area is concentrated along the western side of the San Joaquin Valley from Kern County north into the San Joaquin River Hydrologic Region. Although the San Joaquin Valley has some of the most productive agricultural lands in the world, much of the west side of the valley is plagued by poor subsurface drainage that adversely affects crop productivity. Between 1977 and 1991, the area affected by saline shallow groundwater on the west side doubled to approximately 1,200 square miles. A substantial portion of the valley, approximately 4,000 square miles, is threatened by saline shallow groundwater resulting from the lack of proper drainage (DWR, 2005).

From 1994 through 2000, samples were taken from 1,476 public supply water wells in 14 of the 19 groundwater basins and subbasins in this region. Evaluation of analyzed samples shows that 1,049 of the wells, or 71 percent, met the state primary MCLs for drinking water, and 427 wells, or 29 percent, exceeded one or more MCL (DWR, 2003).

South Lahontan Hydrologic Region

Groundwater quality in the South Lahontan Hydrologic Region is of good quality, although there are local impairments. The chemical character of the groundwater varies throughout the region, but most often is of calcium- or sodium-bicarbonate. Near and beneath dry lakes, sodium chloride and sodium sulfate-chloride water is common. Groundwater near the edges of valleys contains lower TDS content than water beneath the central part of the valleys or near dry lakes where water pools and dissolved chemicals concentrate as water evaporates, and may percolate through soils into the groundwater. At the lower elevations in this region, groundwater can be degraded, both naturally from geothermal activity, and as a result of activities such as recreational uses and cattle grazing. Arsenic, a known human carcinogen, is a health concern in the basin, and therefore, in Los Angeles as well. The vast majority of public water supply wells do meet drinking water standards. However, in places where these standards are exceeded, it is most often because of elevated levels of TDS, fluoride, or boron. The USEPA lists 13 sites of contamination in this region. Several domestic water supply wells in the Barstow area have been closed due to historical contamination from industrial and domestic wastewater. Three military installations in the southwestern part of the region are on the federal Superfund National Priorities List because of volatile organic compounds and other hazardous contaminants. In addition, the PG&E chromium groundwater contamination site in Hinkley is also within this region (DWR, 2005).

From 1994 through 2000, samples were taken from 605 public supply water wells in 19 of the 77 basins and subbasins in this region. Analyzed samples indicate that 506 wells, or 84 percent, met the state primary MCLs for drinking water, and 99 wells, or 16 percent, have constituents that exceed one or more MCL (DWR, 2003).

Colorado River Hydrologic Region

The groundwater in the Colorado River Hydrologic Region is impaired in many cases primarily due to high mineral concentrations. The chemical character of groundwater in this region is variable. Cation concentration is dominated by sodium, with calcium common and magnesium appearing less often. Bicarbonate is usually the dominant anion, although sulfate and chloride waters are also common. In basins with closed drainages, water character often changes from calcium-sodium bicarbonate near the margins to sodium chloride or chloride-sulfate beneath a dry lake. It is not uncommon for concentrations of dissolved constituents to rise dramatically toward a dry lake where saturation of mineral salts is reached. An example of this is found in the Bristol Valley Groundwater Basin, where the mineral halite (sodium chloride) is formed and then mined by evaporation of groundwater in trenches in Bristol (dry) Lake. The TDS content of groundwater is high in many of the basins in this region. High fluoride content is common; sulfate content occasionally exceeds drinking water standards; and high nitrate content is common, especially in agricultural areas. Significant water quality concerns include nitrate pollution in Coachella Valley, Lucerne Valley, and Desert Hot Springs.

Two of the primary challenges in this region are overdraft in the Coachella Valley and leaking underground storage tanks. The USEPA has not yet placed any contamination sites in this region on the Superfund National Priorities List; however, one site is being considered because of high pesticide levels (DWR, 2005).

From 1994 through 2000, samples were taken from 314 public supply water wells in 23 of the 64 basins and subbasins in this region. Analyzed samples indicate that 270 wells, or 86 percent, met the state primary MCLs for drinking water standards, and 44 wells, or 14 percent, have constituents that exceed one or more MCL (DWR, 2003).

11.2.2 Secondary Study Area

11.2.2.1 Shasta Lake Area

The quality of water in underground basins and water-bearing soils is considered good throughout most of Shasta County. Little groundwater quality data are available from the vicinity of Shasta Lake because this area is not a designated groundwater basin. Potential hazards to groundwater quality involve nitrates and dissolved solids from agricultural and range practices, and septic tank failures. The ability of soils in Shasta County to support septic tanks and on-site wastewater treatment systems is for the most part severely limited, particularly on older valley terrace soils and certain loosely confined volcanic soils in the eastern portions of the county.

11.2.2.2 Sacramento River Downstream of Lake Shasta

The area of the Sacramento River downstream of Lake Shasta includes Keswick Reservoir, the RBPP, the Sutter Bypass, and the Yolo Bypass. In the Redding area downstream of Lake Shasta, groundwater composition varies. In some locations, it is characterized as magnesium-calcium bicarbonate and calcium-magnesium bicarbonate type water, some as magnesium-sodium bicarbonate and sodium-magnesium bicarbonate, some as sodium bicarbonate and sodium chloride type, and other areas as mixed cationic bicarbonate. TDS concentrations range from 70 to 360 mg/L (DWR, 2011a). Groundwater quality impairments include localized high boron, iron, manganese, and nitrate. High levels of total dissolved salts and chlorides are present in the lower Tehama and Tuscan formations. Sodium and boron is present at shallow depth where wells draw from the Chico Formation.

From the Shasta County line south, groundwater composition in the subbasins along the Sacramento River is characterized as calcium-magnesium bicarbonate and magnesium-calcium bicarbonate. TDS concentrations range from 120 to 558 mg/L (DWR, 2011a). Groundwater quality impairments are not widespread, are typically localized, and can include boron, chloride, high magnesium, TDS, calcium, and phosphorus. High nitrate concentrations have been noted in the Antelope area near Red Bluff (DWR, 1987) and in Chico (DWR, 1984). Also, in the Chico area, eight groundwater contamination plumes of PCE, trichloroethylene (TCE), pentachlorophenol (PCP), or chloroform were identified (DTSC, 2004).

The United States Geological Survey (USGS), in cooperation with the California State Water Resources Control Board (SWRCB), sampled 66 wells in 2007 to 2008 in the Shasta and Tehama County area as part of their Groundwater Ambient Monitoring and Assessment (GAMA) Program. The concentrations of most constituents detected in groundwater samples from these wells were below drinking water thresholds. Volatile organic compounds (VOC) and pesticides were detected in less than 25 percent of the samples, and were generally less than one hundredth of any health-based thresholds.

N-nitrosodimethylamine (NDMA) was detected above the California Notification Level in one grid well. Concentrations of all nutrients and trace elements in samples from study unit wells were below the health based thresholds, with the exception of arsenic in three samples, which was above the California MCL. A few samples contained iron, manganese, or pH at levels above the California secondary MCL or USEPA secondary MCL (USGS, 2009).

From Orland south, on the west side of the Sacramento River, calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types. Calcium bicarbonate waters occur locally from Orland to Artois, and near Stony Creek. Mixed character waters for different regions of the subbasin occur as follows: sodium bicarbonate waters from the Williams-Colusa area south to

Grimes; magnesium-sodium bicarbonate or sodium-magnesium bicarbonate waters near the Williams-Arbuckle area and locally near Zamora; and magnesium bicarbonate waters locally near Dunnigan. TDS values range from 120 to 1,220 mg/L, averaging 391 mg/L. Impairments in this range include high EC, TDS, nitrate; manganese impairments occur near Colusa. High TDS and boron occur near Knights Landing. High nitrates occur in Arbuckle, Knights Landing, and Willows. Localized areas have high manganese, fluoride, magnesium, sodium, iron, chloride, TDS, ammonia, and phosphorus (DWR, 2003).

In Sutter County, data collected by the California Department of Water Resources (DWR) from several wells indicate a TDS range of 133 to 1,660 mg/L. The primary groundwater chemistry in the subbasin is characterized by calcium, magnesium, sodium, chloride, sulfate and bicarbonate, which may occur in any combination. Groundwater containing calcium-magnesium bicarbonate or magnesium-calcium bicarbonate exists in the northwest portion of the subbasin. Some groundwater quality data collected indicates some wells drilled to various depths contain chemical elements and compounds in amounts that exceed drinking water quality safety and aesthetic standards. Groundwater quality impairments in some portions of the County have naturally occurring levels of minerals, which present some concerns (taste, economics) (DWR, 2003).

The USGS collected samples from 108 wells in Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba counties as part of the GAMA program (it also covers portions east of the Sacramento River presented in the Feather River discussion in Section 11.2.2.5). Most constituents that were detected in groundwater samples were found at concentrations below drinking water thresholds. VOCs were detected in less than 33 percent of the wells, and pesticides and pesticide degradation products in more than 50 percent of the wells. All detections of these constituents in samples from all wells of this study unit were below health-based thresholds. All detections of trace elements in samples from this study unit's wells were below health-based thresholds, with the exceptions of arsenic and boron. Arsenic concentrations were above the California MCL threshold in eight grid wells, and boron concentrations were above the California notification level in two wells. Although the USGS study was primarily designed to evaluate quality for drinking water wells, they did sample some other well types to add additional information to the study. Arsenic was detected above the California MCL in two of these wells, and arsenic, barium, boron, molybdenum, strontium, and vanadium were detected above health-based thresholds in a few rice irrigation wells; again these wells are not used to supply drinking water. Chloride and sulfate concentrations exceeded California secondary MCL thresholds in two wells and one well, respectively. Iron, manganese, and total dissolved solids concentrations were above the California secondary MCL thresholds in one, 12, and six wells, respectively. Nitrate (nitrite plus nitrate, as dissolved nitrogen) concentrations from two wells were above the California MCL (USGS, 2008).

South of Colusa County, the Sacramento River flows between Yolo and Solano counties to the west, and Sacramento County to the east. To the east, on the north side of the American River, the chemistry and quality of groundwater has been assessed for the American Basin. Many areas of good quality groundwater exist in the North American subbasin. In some portions of the basin, groundwater quality is marginal. The three major groundwater types are: magnesium-calcium bicarbonate or calcium-magnesium bicarbonate; magnesium-sodium bicarbonate or sodium-magnesium bicarbonate; and sodium-calcium bicarbonate or calcium-sodium bicarbonate (DWR, 1997).

Comparison of groundwater quality data with applicable water quality standards and guidelines for drinking and irrigation indicate elevated levels of some water quality parameters. This list includes TDS/specific conductance (measurements of dissolved substances in water), chloride, sodium,

bicarbonate, boron, fluoride, nitrate, and iron, manganese. Arsenic may also be of concern in some locations within the subbasin (DWR, 1997).

High TDS levels exist in an area along the Sacramento River extending from Sacramento International Airport northward to the Bear River. The highest levels of TDS are found in an area extending just south of Nicholas to Verona, between Reclamation District 1001 and the Sutter Bypass. Some wells in this area have reported TDS concentrations exceeding 1,000 mg/L. This same area along the Sacramento River extending from Sacramento International Airport northward to the Bear River also contains high levels of chloride, sodium, bicarbonate, manganese, and arsenic. The groundwater in the southern part of the basin is characterized as of fairly good quality, low in disinfection by-product precursor materials, and moderate in mineral content, although some localized contamination issues exist.

Impairments include three sites within the subbasin with significant groundwater contamination issues: the former McClellan AFB, Union Pacific Railroad Rail Yard in Roseville, and the Aerojet Superfund Site. Although the Aerojet site is south of the North American subbasin, a contaminant plume (including TCE and PCE) extends north from Aerojet, under the American River, and into the North American subbasin as described in a 2000 study by Montgomery Watson (as cited in DWR, 2003). Other localized areas of contamination exist throughout the basin and are usually smaller in scope and extent of contamination (DWR, 2003).

On the south side of the American River, groundwater is typically characterized by calcium-magnesium bicarbonate or magnesium-calcium bicarbonate. Other minor groundwater types include sodium calcium bicarbonate or calcium sodium bicarbonate in the vicinity of Elk Grove, and a magnesium sodium bicarbonate or sodium magnesium bicarbonate near the confluence of the Sacramento and American rivers. TDS concentrations range from 24 to 581 mg/L, and average 221mg/L, based on 462 records from a 1991 report by Bertoldi and others (as cited in DWR, 2003). Impairments to the south of the American River include 7 sites within the subbasin with significant groundwater contamination have been identified in a 1997 report by Montgomery Watson (as cited in DWR, 2003). Included in the list are three USEPA Superfund sites: Aerojet, Mather Field, and the Sacramento Army Depot. Other sites are the Kiefer Boulevard Landfill, an abandoned PG&E site on Jiboom Street near Old Sacramento, and the Southern Pacific and Union Pacific rail yards in downtown Sacramento (DWR, 2003).

To the west of Sacramento County, groundwater in the Yolo region is characterized as a sodium magnesium, calcium magnesium, or magnesium bicarbonate type. The quality is considered well for both agricultural and municipal uses, even though the water is considered hard to very hard (typically over 180 mg/L CaCO_3). Selenium and boron are found in higher concentrations locally as noted in a 1985 report by KID. Evensong (as cited in DWR, 2003). TDS concentrations range from 107 to 1,300 mg/L, and average 574 mg/L noted in a 2000 report by California Department of Health Services (as cited in DWR, 2003). Localized impairments include elevated concentrations of boron (as high as two to three mg/L) in groundwater along Cache Creek and in the Cache Creek Settling Basin area (DWR, 2003). Woodland has experienced nitrate contamination in certain wells. The City of Davis has experienced selenium contamination and localized areas of nitrate contamination. The Central Valley Regional Water Quality Control Board reported several sites in Davis, Woodland, West Sacramento, and Dunnigan with MTBE contamination (YCFCWCD, 2000).

Groundwater within the Solano subbasin is considered to be of fairly good quality, and useable for beneficial uses. Groundwater characterization is primarily magnesium bicarbonate in the central and northern areas, sodium bicarbonate in the southern and eastern areas, and calcium magnesium or

magnesium calcium bicarbonate around and west of Dixon. TDS values range from between 250 and 500 mg/L in the northwest and eastern portion of the basin, and are found at levels higher than 500 mg/L in the central and southern areas. Data from DHS show the TDS minimum of 150, maximum 880, and average of 427 mg/L. In general, most of the water within the subbasin is classified as hard to very hard. Chloride concentrations are found over 100 mg/L in the southern areas, while sulfate concentration is greater than 50 mg/L in the southern areas. Boron concentrations are less than 0.75 mg/L, except in the southern and southeastern basin where concentrations average between 0.75 and 2.0 mg/L. Iron concentrations increase toward the eastern side of the subbasin, from less than 0.02 mg/L to greater than 0.05 mg/L along the Sacramento River, and manganese concentrations also increase from west to east with concentrations from .01 to over 0.1 mg/L found north of Rio Vista and east of the Solano-Yolo County line. Groundwater in this area is rather hard. High concentrations of bicarbonate, which cause precipitation of Ca and Mg carbonates, are found in the southern portion of the basin. Other impairments to groundwater include arsenic, where concentrations are typically between 0.02 and 0.05 mg/L, with the highest concentrations found along the southeastern margin of the basin, and manganese, which is found at concentrations above the MCL of 0.05 mg/L along the Sacramento River along the eastern portion of the subbasin (DWR, 2003).

Groundwater quality within the Capay Valley Subbasin is derived almost exclusively from Cache Creek and its tributaries. Consequently, water quality samples taken from Cache Creek within the Capay Valley reflect the quality of the water within the groundwater basin. Water samples taken from a diversion dam near the lower end of the Capay Valley indicate principally good quality calcium-sodium bicarbonate-type with moderate to very high hardness. Highly mineralized water from Bear Creek and North Fork Cache Creek is a primary source of mineral constituents, especially boron, in groundwater in the Capay Valley Subbasin. Total dissolved solids measured in water taken from six wells in the Capay Valley range from approximately 300 to 500 mg/L, and are comparable to those found in water samples taken from Cache Creek (DWR, 2003).

11.2.2.3 Whiskeytown Area

The Whiskeytown area includes Whiskeytown Lake, Clear Creek, and Spring Creek. Little information is available from the mountainous portions of the Clear Creek and Spring Creek watersheds regarding groundwater quality because these creeks are not located within a defined groundwater basin, and as such, have not been assessed. Most groundwater in this area is high in iron and aluminum due to the minerals in the rock (NPS, 2004).

After Clear Creek enters the valley floor, it enters the Redding Groundwater Basin and Anderson Subbasin. Groundwater in the subbasin is characterized as magnesium-sodium bicarbonate and sodium-magnesium bicarbonate type waters. TDS concentrations range from 109 to 320 mg/L, averaging 194 mg/L. Localized areas with high iron, manganese, and nitrate occur in the subbasin (DWR, 2003).

11.2.2.4 Trinity River Watershed

The Trinity River watershed includes Trinity Lake, the Trinity River, Lewiston Lake, and the Klamath River downstream of the Trinity River. Nearly the entire length of the Trinity River watershed is outside of defined groundwater basins. Therefore, groundwater quality information is sparse. Septic tank failures along the Trinity River downstream from Lewiston Dam are a concern because of potential impacts to groundwater wells and recreational water quality (DWR, 2005).

In the Hoopa area, groundwater is predominantly calcium-magnesium bicarbonate in character. TDS concentrations range from 95 to 159 mg/L, and average 125 mg/L. The primary groundwater quality impairments in the basin are locally high iron concentrations, and low pH values (most ranging from 6.1 to 6.9) (DWR, 2011a).

In the Lower Klamath River Valley area, groundwater is predominantly calcium bicarbonate. TDS concentrations range from 49 to 508 mg/L, and average 196 mg/L. Localized areas with high aluminum, iron, manganese, and TDS occur in the basin (DWR, 2011a).

11.2.2.5 Feather River Area

The Feather River area includes Lake Oroville, the Feather River, and the Thermalito Complex. Groundwater in the area of the Feather River downstream of Lake Oroville, as it flows through Butte County, is predominantly calcium-magnesium bicarbonate and magnesium-calcium bicarbonate waters in the Sacramento River Hydrologic Region. Magnesium bicarbonate waters occur locally near the Biggs-Gridley area, south and east to the Feather River. TDS concentrations range from 75 to 801 mg/L, averaging 235 mg/L (DWR, 2004). Localized high concentrations of manganese, iron, magnesium, TDS, specific conductance, and calcium occur in this area (DWR, 2003).

As the Feather River flows through Yuba County, the good groundwater quality characteristics are apparent in the overall salinity of groundwater in the Secondary Study area. TDS concentrations in the area are typically below 500 mg/L throughout the entire basin. Data collected from wells indicate a TDS concentration range of 141 to 686 mg/L. The primary water chemistry in the area indicates calcium-magnesium bicarbonate or magnesium-calcium bicarbonate groundwater. Some magnesium bicarbonate exists in the northwest portion of the basin (DWR, 2003).

In the Sutter County area, the region includes both the Feather and Sacramento rivers as they near their confluence. Therefore, groundwater quality co increased levels of selenium present in the groundwater supplies for the City of Davis, conditions are similar to those discussed in the appropriate areas for the Sacramento River downstream of Lake Shasta (Section 11.2.2.2).

Also, the USGS did some water quality sampling in this area for the GAMA Program, as discussed previously in Section 11.2.2.2 (Sacramento River Downstream of Lake Shasta), because their sampling encompassed the entire mid portion of the Sacramento Valley.

11.2.2.6 American River Area

The American River area includes Folsom Lake, the American River, and Lake Natoma. In the area near Sacramento, the region includes both the American and Sacramento rivers as they near their confluence. Therefore, groundwater quality conditions are similar to those discussed in the appropriate areas for the Sacramento River downstream of Lake Shasta (Section 11.2.2.2).

11.2.2.7 Delta Region

The Delta region includes the Sacramento-San Joaquin Delta and Suisun Bay. Groundwater quality throughout most of the Delta region is suitable for some urban and agricultural uses, with only local impairments. The character of the groundwater varies in different portions of the Delta. The primary constituents of concern are high TDS, nitrate, boron, chloride, and organic compounds. Other constituents that may have local impairments include arsenic and manganese. As a result of declining water levels, poor quality water has been moving to the east in the Stockton area. Projections indicate that a saline front

is moving to the east approximately 150 to 250 feet per year. Groundwater extraction in the Eastern San Joaquin Subbasin has increased the flow of saline water from the west. There is a concern that the eastward migration of saltwater will degrade portions of the basin, rendering the groundwater unsuitable for urban and agricultural purposes (SJCPWD, 2004).

11.2.2.8 San Francisco Bay Area

The San Francisco Bay area includes San Pablo Bay and San Francisco Bay. Groundwater quality throughout most of the region is suitable for urban and agricultural uses, with only local impairments, such as leaking underground storage tanks. Groundwater in the Livermore Valley and Niles Cone (southern Alameda County) basins has high levels of TDS, chloride, boron, and hardness, such that both Alameda County Flood Control and Water Conservation District-Zone 7 and Alameda County Water District (ACWD) are implementing wellhead demineralization projects to improve the quality of this groundwater supply. In the Santa Clara Valley region, some of the underlying groundwater supplies are threatened by pollutants from various industrial activities and historical agriculture. The Santa Clara Valley Water District (SCVWD) works to protect the quality of these supplies by aggressively responding to pollution threats, such as MTBE, PCE, TCE, and perchlorate. These pollution threats are individually identified and evaluated to prevent or mitigate for groundwater contamination. Elsewhere, groundwater in Petaluma Valley and the Gilroy-Hollister Valley has high levels of nitrate, which adversely impacts the ability to use domestic wells for drinking water purposes. Groundwater recharge projects and the use of imported water have effectively halted land subsidence in most areas, and have successfully stopped or reversed seawater intrusion into aquifers around the bay (DWR, 2005).

11.2.3 Primary Study Area

11.2.3.1 Sites Reservoir, Dams, and Recreation Areas

Groundwater quality data for the proposed Sites Reservoir area are limited¹. Fifteen wells within the proposed Sites Reservoir footprint were sampled in 2005. Groundwater quality in the proposed Sites Reservoir footprint and adjacent area was fair, but high in mineral content. Salinity, measured as specific conductance, ranged from 680 to 2,190 $\mu\text{mhos/cm}$, and TDS values ranged from 375 to 1,291 mg/L. Sampling revealed that no Primary MCLs were exceeded. Of the 15 wells sampled, Secondary MCLs were exceeded for TDS in 14 wells, specific conductance in 12 wells, sulfate in four wells, pH in three wells, manganese and iron in two wells, and aluminum and chloride in one well each. Agricultural Water Quality Goals from the Food and Agriculture Organization of the United Nations (CVRWQCB, 2011) were exceeded for specific conductance and TDS in 14 wells each, sodium in 13 wells, chloride in eight wells, boron in six wells, pH in three wells, and selenium in one well (Appendix 11A).

11.2.3.2 Holthouse Reservoir Complex and Holthouse Reservoir Electrical Switchyard

In the area of the proposed Holthouse Reservoir Electrical Switchyard and the Holthouse Reservoir Complex, which includes the existing Funks Reservoir, there are few wells. One well could be sampled that was near this area. Water from this well was extremely high in mineral content; for example, the specific conductance for this well was 38,200 $\mu\text{mhos/cm}$, and the TDS concentration was 27,400 mg/L.

¹ There are a limited number of well logs for wells in the proposed Sites Reservoir area. Several of these wells were not in use or were otherwise unable to be sampled. There are also several wells in this area for which no well log was available. Two of these wells were sampled to provide data in areas where no other wells were located and where adequate well construction data were provided by the owner/ranch manager.

The Primary MCL for arsenic was exceeded. Secondary MCLs were exceeded for chloride, specific conductance, manganese, and TDS. Agricultural Water Quality Goals were exceeded for boron, chloride, and manganese (Appendix 11A).

11.2.3.3 Glenn-Colusa Irrigation District Canal

Groundwater data from 19 wells in the vicinity of the GCID Canal indicate good quality groundwater in this area. Impairments were not noted to be extensive, but some groundwaters had high mineral content. Specific conductance values ranged from 223 to 1,074 $\mu\text{mhos/cm}$, and TDS values ranged from 120 to 649 mg/L. Primary MCLs exceeded were for nitrite plus nitrate in two wells, and arsenic in one well. Secondary MCLs were exceeded for iron in four wells, TDS in three wells, and aluminum and specific conductance in two wells each. Agricultural Water Quality Goals were exceeded for specific conductance in eight wells, TDS in five wells, sodium in six wells, and copper in one well (DWR, 2007).

11.2.3.4 Tehama-Colusa Canal

Groundwater data from 58 wells sampled along the length of the T-C Canal indicate that the quality of the groundwater along the canal is good, with a few impairments. Specific conductance ranged from 138 to 986 $\mu\text{mhos/cm}$, and TDS values ranged from 112 to 520 mg/L. Nitrate values exceeded the Primary MCL from one well. Secondary MCLs were exceeded for specific conductance, iron, and TDS in three wells each, and pH in one well. Agricultural Water Quality Goals were exceeded for specific conductance in five wells, boron and TDS in three wells each, copper and sodium in two wells each, and pH in one well (DWR, 2007).

11.2.3.5 Delevan Pipeline, Terminal Regulating Reservoir Pipeline, Terminal Regulating Reservoir Pipeline Road, Delevan Transmission Line, and Delevan Pipeline Electrical Switchyard

Data from 19 wells in the vicinity of the Delevan Pipeline, TRR Pipeline, TRR Pipeline Road, Delevan Transmission Line, and Delevan Pipeline Electrical Switchyard locations indicate that groundwater quality in this area is good; however, there are some impairments. This area had groundwater with a high mineral content, but concentrations were lower in proximity to the Sacramento River. Specific conductance values ranged from 324 to 2,245 $\mu\text{mhos/cm}$, and TDS ranged from 204 to 1,324 mg/L. The Primary MCL for arsenic was exceeded in four wells. Secondary MCLs were exceeded for manganese and specific conductance in nine wells each, TDS in eight wells, iron in five wells, and aluminum and sulfate in one well each. Recommended Agricultural Water Quality Limits were exceeded for sodium in 12 wells, specific conductance in 11 wells, TDS in nine wells, chloride and manganese in three wells each, and iron in one well (DWR, 2007).

11.2.3.6 Terminal Regulating Reservoir, Glenn-Colusa Irrigation District Canal Connection to the Terminal Regulating Reservoir, Terminal Regulating Reservoir Pumping/Generating Plant, and Terminal Regulating Reservoir Electrical Switchyard

Data from four wells near the locations of the proposed TRR, GCID Canal Connection to the TRR, TRR Pumping/Generating Plant, and the TRR Electrical Switchyard indicate that groundwater quality in this area is fairly good, but high in mineral content. Specific conductance values ranged from 444 to 1,104 $\mu\text{mhos/cm}$, and TDS ranged from 259 to 608 mg/L. No Primary MCLs were exceeded. Secondary MCLs were exceeded for specific conductance and TDS in two wells each. Agricultural Water Quality

Limits were exceeded for sodium in three wells, specific conductance and TDS in two wells each, and chloride in one well (DWR, 2007).

11.2.3.7 Delevan Pipeline Intake/Discharge Facilities

Data from nine wells near the proposed Delevan Pipeline Intake/Discharge Facilities location indicate that groundwater quality is good, but high in mineral content. Specific conductance values ranged from 324 to 1,090 $\mu\text{mhos/cm}$, and TDS ranged from 204 to 622 mg/L. The Primary MCL for arsenic was exceeded in one well. Secondary MCLs were exceeded for manganese in six wells, specific conductance and iron in three wells each, and TDS in 2 wells. Recommended Agricultural Water Quality Limits were exceeded for specific conductance, sodium, and TDS in three wells each; manganese in two wells; and for arsenic, chloride and iron in one well each (DWR, 2007).

11.2.3.8 Road Relocations, South Bridge, Sites Reservoir Inlet/Outlet Structure, Sites Pumping/Generating Plant, Sites Electrical Switchyard, Tunnel from Sites Pumping/Generating Plant to Sites Reservoir Inlet/Outlet Structure, and Field Office Maintenance Yard

Data from 21 wells near the locations of the proposed Road Relocations, South Bridge, Sites Reservoir Inlet/Outlet Structure, Sites Pumping/Generating Plant, Sites Electrical Switchyard, Tunnel from Sites Pumping/Generating Plant to Sites Reservoir Inlet/Outlet Structure, and Field Office Maintenance Yard were reviewed for groundwater quality in this area. The groundwater quality is fairly good, but impaired somewhat by high mineral content. Specific conductance values ranged from 290 to 2,190 $\mu\text{mhos/cm}$ with 1 well at 38,200 $\mu\text{mhos/cm}$, and TDS ranged from 169 to 1,291 mg/L with 1 well at 27,400 mg/L. The Primary MCL for arsenic was exceeded from one well. Secondary MCLs were exceeded for TDS in 15 wells, specific conductance in 13 wells, manganese, pH, and sulfate each in three wells, and chloride and iron each in two wells. Agricultural Water Quality Goals were exceeded for specific conductance, sodium, and TDS in 14 wells each, chloride in eight wells, boron in six wells, pH in three wells, and selenium in one well (DWR, 2007).

11.2.3.9 Project Buffer

The Project Buffer would surround groupings of Project facilities. Groundwater quality within the Project Buffer would, therefore, be the same as described for each of the Project facilities that are surrounded by the Project Buffer.

11.3 Environmental Impacts/Environmental Consequences

11.3.1 Regulatory Setting

Groundwater quality is regulated at the federal, State, and local levels. Provided below is a list of the applicable regulations. These regulations are discussed in detail in Chapter 4 Environmental Compliance and Permit Summary of this EIR/EIS.

11.3.1.1 Federal Plans, Policies, and Regulations

- Federal Safe Drinking Water Act
- Clean Water Act
- Federal Antidegradation Policy
- Porter-Cologne Water Quality Control Act

11.3.1.2 State Plans, Policies, and Regulations

- California Antidegradation Policy
- Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region
- Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
- Water Quality Control Plan for the Tulare Lake Basin
- Water Quality Control Plan for the North Coast Region

11.3.1.3 Water Quality Control Plan (Basin Plan) for the Sacramento/San Joaquin River Basins

- San Francisco Bay Basin Water Quality Control Plan
- California Code of Regulations – Underground Storage Tanks and Oil or Gas Wells

11.3.1.4 Regional and Local Plans, Policies, and Regulations

- Colusa County General Plan
- Glenn County General Plan
- Colusa County Groundwater Management Plan
- Glenn County Groundwater Ordinance and Management Plan

11.3.2 Evaluation Criteria and Significance Thresholds

Significance criteria represent the thresholds that were used to identify whether an impact would be significant. Appendix G of the *CEQA Guidelines* suggests the following evaluation criteria for hydrology and water quality (no criteria are specifically directed at groundwater quality):

Would the Project:

- Violate any water quality standards or waste discharge requirements?
- Otherwise substantially degrade water quality?

These evaluation criteria used for this impact analysis represent a combination of Appendix G criteria and professional judgment that considers current regulations, standards, and/or consultation with agencies, knowledge of the area, and the context and intensity of the environmental effects, as required pursuant to NEPA. For the purposes of this analysis, an alternative would result in a significant impact to groundwater quality if it would result in any of the following:

- A violation of any water quality standards or waste discharge requirements, a change in groundwater quality resulting in adverse effects to designated beneficial uses of groundwater, or otherwise substantially degrade groundwater quality

11.3.3 Impact Assessment Assumptions and Methodology

11.3.3.1 Assumptions

The following assumptions were made regarding Project-related construction, operation, and maintenance impacts to groundwater quality:

PRELIMINARY – SUBJECT TO CHANGE

- Direct Project-related construction, operation, and maintenance activities would occur in the Primary Study Area.
- Direct Project-related operational effects would occur in the Secondary Study Area.
- The only direct Project-related construction activity that would occur in the Secondary Study Area is the installation of an additional pump into an existing bay at the Red Bluff Pumping Plant.
- The only direct Project-related maintenance activity that would occur in the Secondary Study Area is sediment removal and disposal at the two intake locations (i.e., GCID Canal Intake and Red Bluff Pumping Plant).
- No direct Project-related construction or maintenance activities would occur in the Extended Study Area.
- Direct Project-related operational effects that would occur in the Extended Study Area are related to San Luis Reservoir operation; increased reliability of water supply to agricultural, municipal, and industrial water users; and the provision of an alternate Level 4 wildlife refuge water supply. Indirect effects to the operation of certain facilities that are located in the Extended Study Area, and indirect effects to the consequent water deliveries made by those facilities, would occur as a result of implementing the alternatives.
- The existing bank protection located upstream of the proposed Delevan Pipeline Intake/Discharge facilities would continue to be maintained and remain functional.
- No additional channel stabilization, grade control measures, or dredging in the Sacramento River at or upstream of the Delevan Pipeline Intake/Discharge facilities would be required.

11.3.3.2 Methodology

A combination of data, published reports, modeling results, and professional experience with activities similar to those proposed was used to evaluate the potential impacts to groundwater quality from the alternatives. The data (detailed below) were used to assess existing groundwater quality and anticipate potential impacts that could result from Project-related activities in the three study areas.

The Extended and Secondary study area impact assessments relied on hydrologic and operational modeling performed using CALSIM II, which provided monthly river flows, and reservoir water surface elevations derived from monthly river flows and end-of-month reservoir storages, for the period of simulation extending from water year 1922 through 2003 (82-year simulation period). Detailed discussion of the CALSIM II model is provided in Appendix 6B. These modeling results were used in combination with professional judgment to assess the potential impacts of operation of the alternatives on groundwater quality.

DWR Bulletin 118-03 (DWR, 2003) was referenced to identify the groundwater basins within the Extended, Secondary, and Primary study areas, and to assess the groundwater quality within those basins from earlier assessments. In addition, DWR groundwater monitoring data (DWR, 2011a) were reviewed for the Primary and Secondary study areas.

A survey of DWR well completion report records (DWR, 2011b) was conducted to determine the number and location of wells in the Primary Study Area.

Previously completed studies of potential project effects to groundwater quality, including an Oroville Facilities FERC Relicensing groundwater study, were evaluated to determine the type and severity of impacts that might result in the Primary Study Area from proposed Project-related activities. Worst-case specific conductance (EC) conditions were simulated to assess the surface water quality of the proposed Sites Reservoir (refer to Appendix 7C for a detailed description of the EC Mass Balance Approach and modeling results). Expected surface water quality conditions were then compared to existing groundwater quality conditions to determine if an adverse impact could occur.

11.3.4 Topics Eliminated from Further Analytical Consideration

No Project facilities or topics that are included in the significance criteria listed above were eliminated from further consideration in this chapter.

11.3.5 Impacts Associated with the No Project/No Action Alternative

11.3.5.1 Extended Study Area – No Project/No Action Alternative

Construction, Operation, and Maintenance Impacts

Agricultural, Municipal, Industrial, and Wildlife Refuge Water Use

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Use

The No Project/No Action Alternative includes implementation of projects and programs being constructed, or those that have gained approval, as of June 2009. The impacts of these projects have already been evaluated on a project-by-project basis, pursuant to CEQA and/or NEPA, and their potential for impacts to groundwater quality has been addressed in those environmental documents. Therefore, **there would not be a substantial adverse effect** to groundwater quality.

Groundwater extraction has exceeded groundwater recharge in several areas of the Sacramento and San Joaquin hydrologic regions. This has resulted in lower quality saline water infiltrating further into portions of the valley aquifer. Population growth is expected to occur in California throughout the period of Project analysis (i.e., 100 years), and is included in the assumptions for the No Project/No Action Alternative. Population growth and/or increased agricultural demands could result in increased use of groundwater resources, adding additional stress to existing aquifers which could negatively affect groundwater quality. Continued groundwater extraction at rates that exceed groundwater recharge **could have a substantial adverse effect** on groundwater quality, when compared to Existing Conditions.

San Luis Reservoir

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

With implementation of the No Project/No Action Alternative, San Luis Reservoir would continue to experience water level fluctuations similar to Existing Conditions. Groundwater quality would not be expected to be substantially adversely affected by continued fluctuations. Therefore, continued fluctuations in water levels at San Luis Reservoir **would not have a substantial adverse effect** on groundwater quality, when compared to Existing Conditions.

11.3.5.2 Secondary Study Area – No Project/No Action Alternative

Construction, Operation, and Maintenance Impacts

Trinity Lake, Lewiston Lake, Trinity River, Klamath River Downstream of the Trinity River, Whiskeytown Lake, Spring Creek, Shasta Lake, Sacramento River, Keswick Reservoir, Clear Creek, Lake Oroville, Thermalito Complex (Thermalito Diversion Pool, Thermalito Forebay, and Thermalito Afterbay), Feather River, Sutter Bypass, Yolo Bypass, Folsom Lake, Lake Natoma, American River, Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, San Francisco Bay

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

As explained for the Extended Study Area, the No Project/No Action Alternative includes projects and programs being constructed, or those that have gained approval, as of June 2009. The impacts of these projects have already been evaluated on a project-by-project basis, pursuant to CEQA and/or NEPA, and their potential for impacts to groundwater quality has been addressed in those environmental documents. However, population growth could result in increased use of existing aquifers, which could result in a decline in groundwater quality. Groundwater level data indicate that groundwater extraction has likely exceeded groundwater recharge in several areas of the Sacramento River Hydrologic Region. These areas are scattered throughout the region, but there are areas with higher groundwater overdraft rates in Glenn County and south of the city of Williams in Colusa County. These areas are located in the Sacramento Valley floor groundwater basins. If the No Project/No Action Alternative is implemented, the overdraft rates would likely continue and possibly increase. Continued groundwater extraction at rates that exceed groundwater recharge **could have a substantial adverse effect** on groundwater quality, when compared to Existing Conditions.

11.3.5.3 Primary Study Area – No Project/No Action Alternative

Construction, Operation, and Maintenance Impacts

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Use

Projects included in the No Project/No Action Alternative are not located within the Primary Study Area, and therefore **would not have a substantial adverse effect** on Primary Study Area groundwater quality. With implementation of the No Project/No Action Alternative, local landowners and tenants would continue to use groundwater for domestic use, manage crops with irrigation and pesticides, and raise cattle, which could degrade local groundwater quality. Population growth is projected to be minimal in this area, and **would not have a substantial adverse effect** on groundwater quality due to the small actual increase to the local population in this area, when compared to Existing Conditions.

11.3.6 Impacts Associated with Alternative A

11.3.6.1 Extended Study Area – Alternative A

Construction, Operation, and Maintenance Impacts

Agricultural, Municipal, Industrial, and Wildlife Refuge Water Use

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Use

Because there would not be any Project-related construction work or maintenance activities in the Extended Study Area, there would be **no impact** to groundwater quality associated with these activities.

The provision of an alternate source of wildlife refuge water supply would not affect rates of groundwater use, and would, therefore, have **no impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Project operation would have a beneficial, albeit limited, impact by increasing surface water supply reliability and consequently reducing reliance on groundwater in the CVP and SWP service areas within the Extended Study Area. Increased surface water supply reliability to agricultural, industrial, and municipal water users could result in decreased groundwater pumping. Decreased groundwater pumping would allow groundwater basins to recharge, resulting in improved groundwater quality. Additionally, irrigating with lower salinity water supplied from the Project, rather than groundwater, could alleviate existing increasing soil and groundwater salinity problems that result from evapotranspiration. Therefore, operational effects on groundwater quality within the Extended Study Area would be **potentially beneficial**, when compared to Existing Conditions and the No Project/No Action Alternative.

San Luis Reservoir

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Operational modeling for Alternative A, when compared to Existing Conditions and the No Project/No Action Alternative, indicates that operation of the Project would result in continued water level fluctuations at San Luis Reservoir, but the fluctuations would occur more often and could be more severe. Severe reservoir level drawdowns could result in reduced seepage, which could reduce local groundwater quality. However, San Luis Reservoir currently experiences severe water level fluctuations, and historic groundwater quality ranges should not be substantially adversely affected by continued fluctuations at an increased rate. Therefore, the increased fluctuations in water levels at San Luis Reservoir would have a **less-than-significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

11.3.6.2 Secondary Study Area – Alternative A

Construction, Operation, and Maintenance Impacts

Trinity Lake, Lewiston Lake, Trinity River, Klamath River Downstream of the Trinity River, Whiskeytown Lake, Spring Creek, Shasta Lake, Sacramento River, Keswick Reservoir, Clear Creek, Lake Oroville, Thermalito Complex (Thermalito Diversion Pool, Thermalito Forebay, and Thermalito Afterbay), Feather River, Sutter Bypass, Yolo Bypass, Folsom Lake, Lake Natoma, American River, Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, San Francisco Bay

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Project operation would result in improved surface water storage in reservoir facilities within the Secondary Study Area, which could increase seepage and soil percolation that recharges groundwater in these areas. However, this is not expected to increase at a rate that would have a significant beneficial effect on groundwater quality. Changes to the flow regime of the rivers, creeks, and bypasses could result in changes in the rate of groundwater recharge, but the amount of change is likely to be proportional to the change in flow, which would vary throughout the system. These changes are not expected to substantially affect groundwater quality. Project diversions would not be expected to adversely affect groundwater recharge rates in areas where groundwater extraction has likely exceeded groundwater recharge because Project diversions would occur during periods of excess surface flows and storm events. Therefore, changes in reservoir storage and flow regime would have a **less-than-significant impact** on groundwater quality within the Secondary Study Area, when compared to Existing Conditions and the No Project/No Action Alternative.

The installation, operation, and maintenance of an additional pump into an existing bay at the RBPP would have **no impact** on groundwater quality because it would neither extract groundwater nor increase groundwater recharge, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

The only direct Project-related maintenance activity that would occur within the Secondary Study Area is associated with the removal of sediment from the two existing canal intakes. This activity could result in the use of hazardous materials associated with heavy equipment. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. Contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

11.3.6.3 Primary Study Area – Alternative A

Construction, Operation, and Maintenance Impacts

Sites Reservoir Inundation Area

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

It is likely that, despite the grouting of the underlying rock formations, some water would leak from the reservoir and could increase groundwater recharge in nearby areas outside of the reservoir inundation area. Surface water quality modeling results indicate a worst-case long-term average EC of 190 to 192 $\mu\text{mhos/cm}$ in Sites Reservoir (Appendix 7C), as compared to the range in EC of 680 to 2,190 $\mu\text{mhos/cm}$ measured for existing groundwater quality conditions within the reservoir footprint. The weight of the reservoir could, therefore, force better quality surface water into the reservoir floor. There would also be additional percolation of surface water into the soils, and therefore, groundwater, beneath the reservoir. This surface water could beneficially alter shallow groundwater chemistry in and immediately around the reservoir. Therefore, reservoir inundation could have a potentially **beneficial effect** to shallow groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During construction in the Sites Reservoir Inundation Area it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There are approximately 26 wells and numerous septic systems located within the proposed reservoir inundation area. In addition to water wells, there may be current or historic oil and gas wells, test wells,

and/or boreholes. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality, or the potential for groundwater to contaminate reservoir surface water after inundation. The possible contamination resulting from the improper abandonment and consequent inundation of these wells, boreholes, and septic systems would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

There are not expected to be any underground storage tanks within the reservoir inundation area. However, if any are identified they would need to be located and abandoned pursuant to appropriate codes and regulations.

Sites Reservoir Dams

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Sites and Golden Gate dams would be constructed on Stone Corral and Funks creeks, respectively; flows to those creeks would be maintained during construction. Some redirection of creek flows and stormwater management during construction may result in very minor redirection of groundwater recharge, but not at a rate that would be expected to affect groundwater quality. Following completion of construction, flows would be maintained downstream of the dams. Therefore, the temporary dewatering of Funks and Stone Corral creeks during dam construction would have a **less-than-significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During construction in the Sites Reservoir Dams, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. In addition, during construction, an on-site concrete batch plant may be required. Storage of materials for production of concrete, waste products from this production, or other forms of contamination from associated equipment and construction vehicles could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There may be water wells, septic systems, or current or historic oil and gas wells, test wells, or boreholes at the damsites. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any wells, boreholes, or septic systems would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Temporary dewatering of shallow groundwater may be required during construction. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface waters. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Recreation Areas

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Hazardous Materials

During construction of the Recreation Areas, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. In addition, during operation and maintenance, increased vehicle traffic and use of the recreation areas by recreationists could introduce contaminants (such as fuels, oils, and herbicides) that could enter the environment and subsequently compromise groundwater quality. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There may be test wells or boreholes at the sites planned for Recreation Areas. All test wells and/or boreholes would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any test wells or boreholes would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Septic System, Leach Field, and Vault Toilet Construction

Vault toilets would be installed at all of the Recreation Areas. If they are improperly installed or not maintained correctly, they would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Road Relocations and South Bridge

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Hazardous Materials

During construction of the Road Relocations and South Bridge, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

In addition, on-site batch plants for asphalt or concrete may be required. Storage of materials for production of asphalt or concrete, waste products from this production, or other forms of contamination from associated equipment and construction vehicles could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

During operation, vehicle traffic could have an adverse effect on groundwater quality resulting from spills or leaks. Runoff from materials used during road maintenance and repairs could also adversely affect groundwater quality. Careful management of ongoing road maintenance activities, together with habitat restoration and water quality pollution prevention projects in or adjacent to the road right-of-way, substantially contribute to the prevention of pollution. Combined, or individually, these would have a **less-than-significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There may be water wells, septic systems, or current or historic oil and gas wells, test wells, or boreholes along or adjacent to the road relocations. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any wells, boreholes, or septic systems could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Temporary dewatering of shallow groundwater may be required during construction. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface waters. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Sites Pumping/Generating Plant, Sites Electrical Switchyard, Tunnel from Sites Pumping/Generating Plant to Sites Reservoir Inlet/Outlet Structure, Sites Reservoir Inlet/Outlet Structure, and Field Office Maintenance Yard

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Hazardous Materials

During construction of these facilities, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There may be water wells, septic systems, or current or historic oil and gas wells, test wells, or boreholes along or adjacent to these facilities. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any wells, boreholes, or septic systems could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Construction of the Sites Pumping/Generating Plant, Sites Electrical Switchyard, Sites Reservoir Inlet/Outlet Structure, and Field Office Maintenance Yard may require temporary localized lowering of the shallow groundwater. Construction of the tunnel from the Sites Pumping/Generating Plant to the Sites Reservoir Inlet/Outlet Structure would require dewatering. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface water. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Septic System and Leach Field Construction

Leach fields and a water treatment facility would be installed at the Field Office Maintenance Yard. Septic systems and associated leach fields must be properly sited, designed, installed, operated, and maintained to avoid harmful contamination from wastewater. Improper construction of these systems could result in a **potentially significant impact** to groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Holthouse Reservoir Complex and Holthouse Reservoir Electrical Switchyard

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

During the construction of Holthouse Reservoir, Funks Reservoir would be drained and dredged to design capacity. The reservoir would be drained for up to two years. During this time, groundwater quality may be adversely affected due to reduced seepage and percolation from the drained reservoir. Because this is a temporary activity, and soil permeability is low in the area, the impact to groundwater quality would be **less than significant**, when compared to Existing Conditions and the No Project/No Action Alternative.

Inundation of Holthouse Reservoir would likely lead to higher groundwater levels in a localized area around the reservoir from reservoir leakage and soil percolation. Holthouse Reservoir surface water quality is assumed to be the same as that modeled for Sites Reservoir. Surface water quality modeling results indicate a worst-case long-term average EC of 190 to 192 µmhos/cm for Sites Reservoir (Appendix 7C), as compared to the EC value of 38,200 µmhos/cm measured for existing groundwater quality conditions in the vicinity of Funks Reservoir. Therefore, this would be a **beneficial effect** because shallow groundwater quality would be improved with better quality reservoir water, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During the dredging of Funks Reservoir, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

During the construction of the Holthouse Reservoir Complex and Holthouse Reservoir Electrical Switchyard, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There are approximately three wells within a one-mile radius of these facilities. There may also be septic systems, current or historic oil and gas wells, test wells, or boreholes along or adjacent to the Holthouse Reservoir Complex and Holthouse Reservoir Electrical Switchyard. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any wells, boreholes, or septic systems could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Construction of the Holthouse Reservoir Complex and Holthouse Reservoir Electrical Switchyard may require temporary localized lowering of the shallow groundwater. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface water. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Terminal Regulating Reservoir, Terminal Regulating Reservoir Pipeline, Terminal Regulating Reservoir Pipeline Road, Terminal Regulating Reservoir Pumping/Generating Plant, Terminal Regulating Reservoir Electrical Switchyard, and Glenn-Colusa Irrigation District Canal Connection to the Terminal Regulating Reservoir

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Inundation of the TRR would likely lead to higher groundwater levels in a localized area around the reservoir from reservoir leakage and soil percolation. TRR surface water quality is assumed to be the same as that modeled for Sites Reservoir. Surface water quality modeling results indicate a worst-case long-term average EC of 190 to 192 $\mu\text{mhos/cm}$ in Sites Reservoir (Appendix 7C), as compared to the range in EC of 444 to 1,104 $\mu\text{mhos/cm}$ measured for existing groundwater quality conditions in the vicinity of the proposed TRR. Therefore, this would have a **beneficial effect** because shallow groundwater quality would be improved with better quality reservoir water, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During the construction of the TRR and associated facilities, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

There are approximately 10 wells within a one-mile radius of the proposed TRR. There may also be septic systems, or current or historic oil and gas wells, test wells, or boreholes along or adjacent to these TRR facilities. All well types, boreholes, and septic systems would need to be located, identified, and properly abandoned before or during construction; otherwise, they have the potential of creating a conduit for significant contaminant impacts to groundwater quality. The possible contamination resulting from the improper abandonment of any wells, boreholes, or septic systems could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Construction of these TRR facilities may require temporary localized lowering of the shallow groundwater. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface waters. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Underground Utilities

The proposed TRR Pipeline route would cross an existing PG&E gas line. It is possible that other gas lines exist along the pipeline route. All underground utilities would need to be located prior to construction to ensure that no damage is incurred during construction of the pipeline. If gas lines are damaged, they could allow gas to leak into groundwater, which would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Glenn-Colusa Irrigation District Canal Facilities Modifications

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

A portion of the earthen channel of the GCID Canal would be dewatered while 200 feet of the canal are lined with concrete. However, this construction is expected to occur during the regularly scheduled annual maintenance period for the canal, and would, therefore, not be expected to adversely affect groundwater recharge or quality. Once the canal is lined, there could be a reduction in the localized rate of groundwater recharge. However, because only 200 feet of canal would be lined, the potential subsequent loss of recharge in that small area would have a **less-than-significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During modifications of the GCID Canal facilities, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Delevan Transmission Line

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Hazardous Materials

During construction of the Delevan Transmission Line, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Delevan Pipeline and Delevan Pipeline Electrical Switchyard

Impact GW Qual-I: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Hazardous Materials

During construction of the Delevan Pipeline and Delevan Pipeline Electrical Switchyard, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Temporary dewatering of shallow groundwater may be required during construction of these facilities. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface water. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Underground Utilities

The Delevan Pipeline route would cross an existing PG&E gas line. It is possible that other gas lines exist along the pipeline route. All underground utilities need to be located prior to construction to ensure that no damage is incurred during construction of the pipeline. If gas lines are damaged, they could allow gas to leak into groundwater, which would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Delevan Pipeline Intake Facilities

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Temporary dewatering of shallow groundwater may be required during construction. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Additionally, water from dewatering operations would need to be stored and properly handled and disposed of to avoid potentially contaminating surface water. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality.

Filling of the intake forebay would likely lead to higher groundwater levels in a localized area around the forebay from leakage and soil percolation. Forebay surface water quality is assumed to be the same as that modeled for Sites Reservoir. Surface water quality modeling results indicate a worst-case long-term average EC of 190 to 192 $\mu\text{mhos/cm}$ in Sites Reservoir (Appendix 7C), as compared to the range in EC of 324 to 1,090 $\mu\text{mhos/cm}$ measured for existing groundwater quality conditions in the vicinity of the facilities footprint. This would be a **potentially beneficial effect** because shallow groundwater quality would be improved with better quality surface water, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During construction of the Delevan Pipeline Intake Facilities, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Dewatering

Construction of the Delevan Pipeline Intake Facilities would require dewatering of shallow groundwater. Dewatering could expose soils and shallow groundwater to contamination from stormwater, construction materials, wastes, or other spilled materials. Contamination as a result of dewatering could have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Project Buffer

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Existing structures within the Project Buffer would be demolished, and any agricultural fields that are currently irrigated would not continue to receive irrigation. Any wells associated with those structures or used as irrigation sources may, therefore, no longer be used. The discontinued use of any wells could

increase groundwater recharge, resulting in a **less-than-significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Hazardous Materials

During demolition of structures that are located within the Project Buffer, it is possible that the operation and maintenance of construction equipment could result in hazardous materials spills. These materials could pose a significant risk if misused or improperly handled and stored. Leaks and spills could enter the soil and potentially contaminate groundwater. The potential contamination of groundwater from hazardous materials would have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

11.3.7 Impacts Associated with Alternative B

11.3.7.1 Extended Study Area – Alternative B

Construction, Operation, and Maintenance Impacts

The impacts associated with Alternative B, as they relate to groundwater quality (**Impact GW Qual-1**), would be the same as described for Alternative A for the Extended Study Area.

11.3.7.2 Secondary Study Area – Alternative B

Construction, Operation, and Maintenance Impacts

The impacts associated with Alternative B, as they relate to groundwater quality (**Impact GW Qual-1**), would be the same as described for Alternative A for the Secondary Study Area.

11.3.7.3 Primary Study Area – Alternative B

Construction, Operation, and Maintenance Impacts

The following Primary Study Area Project facilities are included in both Alternatives A and B. These facilities would require the same construction methods and operation and maintenance activities regardless of alternative, and would, therefore, result in the same construction, operation, and maintenance impacts to groundwater quality:

- Recreation Areas
- Sites Pumping/Generating Plant
- Sites Electrical Switchyard
- Tunnel from Sites Pumping/Generating Plant to Sites Reservoir Inlet/Outlet Structure
- Sites Reservoir Inlet/Outlet Structure
- Field Office Maintenance Yard
- Holthouse Reservoir Complex
- Holthouse Reservoir Electrical Switchyard
- GCID Canal Facilities Modifications
- GCID Canal Connection to the TRR
- TRR
- TRR Pumping/Generating Plant
- TRR Electrical Switchyard
- TRR Pipeline

- TRR Pipeline Road
- Delevan Pipeline
- Delevan Pipeline Electrical Switchyard

If Alternative B is implemented, the footprint or construction disturbance area of Sites Reservoir and Dams, the Road Relocations and South Bridge, and the Delevan Transmission Line would differ from Alternative A. In addition, the Delevan Pipeline Intake Facilities would be replaced by the Delevan Pipeline Discharge Facility. The boundary of the Project Buffer would be the same for Alternatives A and B, but because the footprints of some of the Project facilities that are included in the Project Buffer would differ between the alternatives, the acreage of land within the Project Buffer would also differ. However, these differences in the size of the facility footprint, alignment, or construction disturbance area would not change the type of construction, operation, and maintenance activities that were described for Alternative A. They would, therefore, have the same impact on groundwater quality (**Impact GW Qual-1**) as described for Alternative A, with the exclusion of the potential impacts associated with the Delevan Pipeline Intake Facility forebay and afterbay that are included in Alternative A, but not Alternative B.

The Sites Reservoir Inundation Area would increase from a 1.27-MAF capacity (with Alternative A) to a 1.81-MAF capacity (with Alternative B). The larger reservoir size associated with Alternative B would require the same type of construction, operation, and maintenance activities as for Alternative A, and would, therefore, have the same potential for impact from hazardous materials (**Impact GW Qual-1: Hazardous Materials**) as described for Alternative A. Potential impacts associated with a larger reservoir on rates of groundwater recharge and abandoned wells, septic systems, or underground storage tanks are described below.

Sites Reservoir Inundation Area

Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality

Changes in Rates of Groundwater Recharge

Refer to the **Impact GW Qual-1** discussion for the Alternative A Sites Reservoir Inundation Area. The greater volume of water in the Alternative B reservoir would not appreciably change the rate of groundwater forced into the soil from the weight of the reservoir water and from natural percolation from that described for Alternative A. It could, however, beneficially alter shallow groundwater chemistry in and immediately around the reservoir, as described for Alternative A. Therefore, the Sites Reservoir Inundation Area could have a **potentially beneficial effect** to shallow groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

Abandoned Wells, Septic Systems, or Underground Storage Tanks

Refer to the **Impact GW Qual-1** discussion for the Alternative A Sites Reservoir Inundation Area. It is possible that the larger reservoir would inundate additional wells, septic systems, boreholes, or underground storage tanks than Alternative A, but the number of potential additional wells associated with Alternative B would be small relative to the total number affected. Regardless of whether additional impacts would occur in comparison to Alternative A, the possible contamination resulting from the improper abandonment and consequent inundation of these wells, boreholes, and septic systems would

have a **potentially significant impact** on groundwater quality, when compared to Existing Conditions and the No Project/No Action Alternative.

11.3.8 Impacts Associated with Alternative C

11.3.8.1 Extended Study Area – Alternative C

Construction, Operation, and Maintenance Impacts

The impacts associated with Alternative C, as they relate to groundwater quality (**Impact GW Qual-1**), would be the same as described for Alternative A for the Extended Study Area.

11.3.8.2 Secondary Study Area – Alternative C

Construction, Operation, and Maintenance Impacts

The impacts associated with Alternative C, as they relate to groundwater quality (**Impact GW Qual-1**), would be the same as described for Alternative A for the Secondary Study Area.

11.3.8.3 Primary Study Area – Alternative C

Construction, Operation, and Maintenance Impacts

The following Primary Study Area Project facilities are included in Alternatives A, B, and C. These facilities would require the same construction methods and operation and maintenance activities regardless of alternative, and would, therefore, result in the same construction, operation, and maintenance impacts to groundwater quality:

- Recreation Areas
- Sites Pumping/Generating Plant
- Sites Electrical Switchyard
- Tunnel from Sites Pumping/Generating Plant to Sites Reservoir Inlet/Outlet Structure
- Sites Reservoir Inlet/Outlet Structure
- Field Office Maintenance Yard
- Holthouse Reservoir Complex
- Holthouse Reservoir Electrical Switchyard
- GCID Canal Facilities Modifications
- GCID Canal Connection to the TRR
- TRR
- TRR Pumping/Generating Plant
- TRR Electrical Switchyard
- TRR Pipeline
- TRR Pipeline Road
- Delevan Pipeline
- Delevan Pipeline Electrical Switchyard

The Alternative C design of the Delevan Transmission Line and Delevan Pipeline Intake Facilities is the same as described for Alternative A. These facilities would require the same construction methods and operation and maintenance activities regardless of alternative, and would, therefore, result in the same construction, operation, and maintenance impacts to groundwater quality (**Impact GW Qual-1**) as described for Alternative A.

The Alternative C design of the Sites Reservoir Inundation Area and Dams, Recreation Facilities, and Road Relocations and South Bridge is the same as described for Alternative B. These facilities would require the same construction methods and operation and maintenance activities regardless of alternative, and would, therefore, result in the same construction, operation, and maintenance impacts to groundwater quality (**Impact GW Qual-1**) as described for Alternative B.

The boundary of the Project Buffer would be the same for all alternatives, but because the footprints of some of the Project facilities that are included in the Project Buffer would differ between the alternatives, the acreage of land within the Project Buffer would also differ. However, these differences in the size of the area included within the buffer would not change the type of construction, operation, and maintenance activities that were described for Alternative A. They would, therefore, have the same impact on groundwater quality (**Impact GW Qual-1**) as described for Alternative A.

11.4 Mitigation Measures

Mitigation measures are provided below and summarized in Table 11-1 for the impacts that have been identified as significant or potentially significant.

**Table 11-1
Summary of Mitigation Measures for
NODOS Project Impacts to Groundwater Quality**

Impact	Associated Project Facility	LOS Before Mitigation	Mitigation Measure	LOS After Mitigation
Impact GW Qual-1: A Violation of any Water Quality Standards or Waste Discharge Requirements, a Change in Groundwater Quality Resulting in Adverse Effects to Designated Beneficial Uses of Groundwater, or Otherwise Substantially Degrade Groundwater Quality				
Impact GW Qual-1a: Hazardous Materials	Sediment Removal at the T-C and GCID Canal Intakes; All Primary Study Area Project facilities	Potentially Significant	Mitigation Measure SW Qual-1e: Prepare and Implement a Stormwater Pollution Prevention Plan	Less than Significant
Impact GW Qual-1b: Abandoned Wells, Septic Systems, or Underground Storage Tanks	Sites Reservoir and Dams, Recreation Facilities, Road Relocations, Sites Pumping/Generating Plant, Sites Electrical Switchyard, Tunnel, Sites Reservoir Inlet/Outlet Structure, Field Office Maintenance Yard, Holthouse Reservoir Complex, TRR, TRR Pipeline, TRR Pumping/Generating Plant, TRR to Funks Creek Pipeline, GCID Connection to TRR	Potentially Significant	Mitigation Measure GW Qual-1b: Implement DWR and County Standards for the Proper Abandonment of Wells, Boreholes, and Septic Systems	Less than Significant

**Table 11-1
Summary of Mitigation Measures for
NODOS Project Impacts to Groundwater Quality**

Impact	Associated Project Facility	LOS Before Mitigation	Mitigation Measure	LOS After Mitigation
Impact GW Qual-1c: Dewatering	Sites Reservoir Dams, Road Relocations, Sites Pumping/Generating Plant, Sites Electrical Switchyard, Tunnel, Sites Reservoir Inlet/Outlet Structure, Field Office Maintenance Yard, Holthouse Reservoir Complex, TRR, TRR Pipeline, TRR Pumping/Generating Plant, TRR to Funks Creek Pipeline, GCID Connection to TRR, Delevan Pipeline, Delevan Pipeline Intake/Discharge Facilities	Potentially Significant	Mitigation Measure GW Qual-1c: Implement Caltrans Field Guide to Construction Site Dewatering	Less than Significant
Impact GW Qual-1d: Underground Utilities	TRR Pipeline, Delevan Pipeline	Potentially Significant	Mitigation Measure GW Qual-1d: Identify Underground Utilities Prior to Start of Construction	Less than Significant
Impact GW Qual-1e: Septic System, Leach Field, and Vault Toilet Construction	Recreation Facilities, Field Office Maintenance Yard	Potentially Significant	Mitigation Measure GW Qual-1e: Construct Septic Systems, Leach Fields, and Vault Toilets in Accordance with County Permit Specifications	Less than Significant

Note:

LOS = Level of Significance

Mitigation Measure SW Qual-1e: Prepare and Implement a Stormwater Pollution Prevention Plan

DWR and Reclamation shall prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) that emphasizes proper hazardous materials storage and handling procedures; shall outline spill containment, cleanup, and reporting procedures; and shall limit refueling and other hazardous activities to designated areas. Signs prohibiting refueling shall be posted in sensitive areas. Equipment shall be inspected prior to use each day to ensure that hydraulic hoses are tight and in good condition. Other appropriate BMPs, such as use of concrete washout basins and proper waste management, securely locating and maintaining portable toilets, combined with visual observation and water sample collection and analysis, shall be used to prevent discharge of possible contaminants and chemicals associated with construction, maintenance, or operations activities to reduce potentially significant contamination impacts to groundwater quality to a **less-than-significant level**. Details of these BMPs are described in Section WM-4 of the *Construction Site Best Management Practices Manual* (Caltrans, 2003).

PRELIMINARY – SUBJECT TO CHANGE

Mitigation Measure GW Qual-1b: Implement DWR and County Standards for the Proper Abandonment of Wells, Boreholes, and Septic Systems

According to DWR's Water Well Standards (DWR, 2012), a well that is no longer useful (including exploration and test holes) must be destroyed to assure that the existing groundwater quality and proposed Project water quality is protected and preserved for further use, and to eliminate any potential physical hazard. Destruction of a well shall consist of the complete filling of the well in accordance with the procedures described in DWR Water Well Standards Section 23. Permits for well destruction shall also be obtained from the appropriate County agency (Glenn or Colusa).

Any current or historic oil and gas wells detected within the Project facility footprints shall be addressed. Any well types that would be inundated shall be properly sealed and abandoned according to policies and procedures laid out in the California Code of Regulations Title 14 from the Department of Conservation. These wells shall be sealed to ensure that the existing groundwater quality is protected and preserved, and to eliminate any potential physical hazard. Permits for well destruction shall also be obtained from the appropriate County agency (Glenn or Colusa).

Any test holes, boreholes, other potential conduits to groundwater shall also be sealed and destroyed.

Existing septic systems, such as septic tanks, cesspools, and seepage pits, shall be identified and located. These septic systems shall then be properly abandoned and demolished, and, if necessary, removed and disposed of. Destruction of septic systems shall require:

- A licensed septic tank pumper to pump the septic tank. A copy of the receipt for this pumping shall be obtained.
- Abandonment of the tank in accordance with county ordinances, which may include methods such as:
 - Tank removed, then disposed of at a sanitary landfill
 - Tank top removed, tank crushed, then excavation filled with earthen materials to within 12 inches of native surface
 - Tank top removed, bottom perforated, then excavation filled with earthen materials to within 12 inches of native surface

Permits for abandonment and destruction shall also be obtained from the appropriate County (Glenn or Colusa) prior to work.

Mitigation Measure GW Qual-1c: Implement Caltrans Field Guide to Construction Site Dewatering

Effluent from dewatering activities shall be properly stored and disposed of to prevent contamination of surface water. This BMP is intended to prevent the discharge of pollutants from construction site dewatering operations associated with stormwater (accumulated rain) and non-stormwater (e.g., groundwater or water from a diversion or cofferdam). Dewatering effluent that is discharged from the construction site to a storm drain or receiving water is subject to the requirements of the applicable National Pollutant Discharge Elimination System (NPDES) permit. Refer to the *Caltrans Field Guide to Construction Site Dewatering* for detailed guidance for management of dewatering operations (Caltrans, 2001). The dewatering effluent shall be managed according to Central Valley RWQCB requirements and California Stormwater Quality Association BMPs.

Mitigation Measure GW Qual-1d: Identify Underground Utilities Prior to Start of Construction

Underground utilities in the vicinity of Project facility footprints, such as gas or sewer lines, must be identified and located prior to any excavation. This is to ensure excavation activities do not cause damage to the utilities, resulting in utility disruption and/or construction worker safety. Prior to the start of construction, utility providers shall be contacted to identify underground utilities in the vicinity of Project facility footprints.

Mitigation Measure GW Qual-1e: Construct Septic Systems, Leach Fields, and Vault Toilets in Accordance with County Permit Specifications

Septic systems, leach fields, and vault toilets shall be properly sited, designed, installed, operated, and maintained to ensure that wastewater is adequately treated and does not contaminate groundwater. Permits and approvals shall be obtained from Colusa County Environmental Health.

Implementation of **Mitigation Measures SW Qual-1e, GW Qual-1b, GW Qual-1c, GW Qual-1d, and GW Qual-1e** would reduce the level of significance of Project impacts to groundwater quality to **less than significant**.

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